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Effect of Soy Flour and Maize Flour Addition on Phase Separation in *Moi-Moi* from Soaked Cowpea *(Vigna unguiculata)* and Cowpea Flour from Different Cowpea Varieties

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ABSTRACT

Two improved varieties of cowpea (IT89KO and IT90K-76) and one local variety (lsiocha) were used to investigate the effects of added soyflour and maize flour on the phase separation in *moi-moi* made from soaked cowpea and cowpea flour. Different levels (5%, 10%, 15%, 20% and 25%) of maize flour, soyflour and a 1:1 blend of soyflour and maize flour (soy/maize flour) were separately added. The *moi-moi* from the different combinations was evaluated for phase separation and per cent height of the upper layer calculated. Soaking of cowpea reduced the size of the upper layer in *moi-moi* compared with the use of cowpea flour. The addition of maize flour or the soy/maize flour reduced the upper layer compared with when either flour was added alone. The upper layer of *moi-moi* made from cowpea flour with added soy flour (21.20%) was significantly higher ($p < 0.05$) than *moi-moi* from soaked cowpea with added soy flour (15.2%). *Moi-moi* with added maize flour made from cowpea flour produced a significantly ($p < 0.05$) higher mean per cent upper layer (19.72%) compared with that from soaked cowpea (8.95%). Addition of soyflour produced the greatest upper layer for all varieties used. There were no significant ($p > 0.05$) differences in the per cent upper layers for *moi-moi* from all cowpea varieties when maize flour was added. Increasing the proportion of added flours increased the size of the upper layer. Complete prevention of the occurrence of phase separation in *moi-moi* by addition of soy flour and maize flour alone is not feasible.

Keywords: Phase separation, *moi-moi,* soyflour, maize flour and cowpea varieties.

Introduction

Moi-moi is the product made from steamed cowpea paste (IFIS, 2005; Osuji *et al*., 2011). It is popular in Nigeria (Uzuegbu and Eke, 2000) and the West African sub-region (Olakpade *et al*., 2005). It is one of the popular products made from cowpea. Phase separation or the occurrence of different layers in the *moi-moi* structure is a commonly observed occurrence in the product. It could also be a major limiting factor in the widespread consumption of the product (Osuji *et al*., 2007a). It manifests mostly as a softer upper layer and a firmer layer beneath. It adversely affects the appearance of the product. The lack of a uniform structure devoid of phase separation could also retard the development of the product as an industrial commodity and for global distribution (Osuji *et al*., 2011).

Traditionally, not all varieties of cowpea are popular for making *moi-moi*. Some varieties have been identified and are preferred for making *moi-moi*. Osuji *et al.* (2011) reported that the local *Isiocha* variety gave a higher yield of *moi-moi* than some improved varieties. They also observed that *moi-moi* made from different cowpea varieties exhibited phase separation and that phase separation increased with increasing levels of water added during *moi-moi* production. The use of cowpea

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flour for production of *moi-moi* is less cumbersome compared with the production of same by soaking of cowpea grains followed by dehulling, screening of hulls and then wet milling. The use of cowpea flour is becoming a popular urban practice among domestic and commercial producers of *moi-moi*.

Moi-moi is curdled by the steaming of cowpea paste to form a firm gel. The gel is probably formed by the hydration of the cowpea complex carbohydrates in addition to protein coagulation. This is similar to an earlier observation reported for soybean by Urbanski *et al.* (1982) which showed that soybean complex carbohydrates curdled when heated. The lower layer (greater part) of *moi-moi* contains more carbohydrates than the upper layer (Osuji *et al.*, 2007b). In addition to nutritional benefits, the blending of cowpea with soybean and maize flours for making *moi-moi* might reduce the occurrence of phase separation. The addition of soybean could bring the advantage of its nutritional and health benefits (0hr, 2004) and complement the nutritional quality of cowpea. The incorporation of maize flour will improve the content of sulphur containing amino acids, which is deficient in cowpea. The nutritional advantage of blending cereals and legumes have been widely reported (Adeyemi, 1983; Palmer, 1992; Osuji and Nsofor, 2002). When maize starch is used for making custard or *akamu*, it forms an apparently uniform gel. It is hoped that the increase in carbohydrates via the addition of maize flour could make *moi-moi* to curdle in such a way that phase separation may be eliminated. It is important therefore to understand the effect of soy flour and maize flour addition on the occurrence of phase separation in *moi-moi*. This work therefore investigates the occurrence of phase separation in *moi-moi* when soy flour and maize flour are added to cowpea of different varieties. The effects were evaluated for *moi-moi* made from both soaked cowpea and cowpea flour.

Materials and Methods

Two improved varieties of cowpea (IT89KD and IT90K-76) were procured from the Department of Crop Science, Michael Okpara University of Agriculture. Umudike, Abia State, Nigeria. One local variety, lsiocha (the popular cowpea variety for *moi-moi* production), was obtained from the main market, Owerri, Imo State, Nigeria. Cowpea flour, soy flour and maize flour were obtained from a local miller in Owerri, Imo State Nigeria. All flours used for this work were milled in an attrition (plate) mill until they passed through the 250 μm metre sieve. The flours were stored in airtight plastic bottles for further use.

Production of Moi-Moi

Moi-moi was produced as described by Osuji *et al.* (2011). Duplicate 22 g of cowpea samples were separately weighed out from each cowpea variety and used for production of *moi-moi*. Each sample was separately soaked in tap water for 15 min before they were hand dehulled. The hulls were removed by floatation. The soaked cotyledons were milled in an electric Somimax (Model No. N5-360D, NewBrook Corporation Texas, USA) machine for 10 min to form a smooth cowpea slurry. A blend of 0.15 g of salt, 2 ml of vegetable oil, 2.35 g of fresh pepper and 1 g of ground crayfish was blended into the slurry with 33 ml of water. The slurry was transferred into cylindrical stainless steel cups greased with refined vegetable oil, the cups were placed in a pressure cooker and steamed at 121°C for 30 min. The *moi-moi* was then allowed to cool.

The *moi-moi* from cowpea flour was made by mixing 20 g (after adjusting for removal of the hulls) of the cowpea flour with 0.15 g of salt, 2 ml of vegetable oil, 2.35 g of fresh pepper and 1 g of ground crayfish into 33 ml of water followed by stirring to from a smooth cowpea paste. The slurry was processed into *moi-moi* as previously described.

An equivalent quantity of water that was used for the soaked cowpea was applied in making *moi-moi* from cowpea flour after adjusting for the quantity absorbed in the soaked cowpea (Osuji *et al.*, 2011).

Production of moi-moi with added soyflour and maize flour

The process for making *moi-moi* with added soy

flour and maize flour followed the same process as described above. However, the cowpea was separately substituted with 5%, 10%, 15%, 20% and 25% soy flour, maize flour and equal blend (ratio 1:1) soy flour/maize flour to make composite flours from for all cowpea varieties.

Evaluation of phase separation in moi-moi samples

Phase separation in *moi-moi* was evaluated as described in Osuji *et al.* (2011). Cooled *moi-moi* samples from soaked cowpea and cowpea flour were cut into half longitudinally. The length of (a) the upper phase (layer) showing on the longitudinal cross section was measured. The total length (b) of the *moi-moi* was measured. The percentage of the upper layer was calculated thus:

$$\% \text{ upper layer} = \frac{a}{b} \times \frac{100}{1}$$

Statistical analysis

The phase separation data statistically analyzed by analysis of variance (ANOVA) to determine the existence of significant difference in the results obtained from different treatment using SPSS version 16 (2008).

Results and Discussion

Effect of addition of soy flour, maize flour and soy/maize flour on phase separation of moi-moi from soaked cowpea and cowpea flour

The effects of addition of soy flour, maize flour and soy/maize flour to cowpea on the per cent upper layer of *moi-moi* made from soaked cowpea and cowpea flour are shown in Table 1. The per cent upper layer of *moi-moi* made from cowpea flour with added soy flour (21.17%) was significantly higher ($p < 0.05$), than *moi-moi* from soaked cowpea with added soy flour (15.2%). However, the mean % height of the upper layers were more than the one reported by Osuji *et al.* (2011) for cowpea flour alone (7.12%) and soaked cowpea (8.45%). This implies that the added flours promoted the occurrence of phase separation in *moi-moi*. Soybean is lower in carbohydrates and higher in protein than cowpea (Ihekoronye and Ngoddy, 1985). Since the lower layers had more carbohydrate than the upper layer, the addition of soyflour with lower carbohydrate content could have promoted the occurrence of phase separation in *moi-moi* to yield the upper layers which contained more proteins (Osuji *et al*., 2011). It is also possible that starch which is the major component of maize flour promoted the occurrence of phase separation in cowpea flour by having a different rheological behaviour from other complex carbohydrates. Urbanski *et al.* (1982) reported that cell wall fibres of soybean were more responsible for the high apparent viscosities observed in soymilk and had different rheological behaviour from other cell components. Similarly, Osuji and Ubbaonu (2003) reported that the hydrolysis of soybean complex carbohydrates reduced the apparent viscosity of soymilk beverages and increased the shelf life of the medium. The added maize flour promoted phase separation in the reconstituted cowpea flour compared with when wet milled cowpea was used and when soy flour and soy/maize flour was used. The *moi-moi* from cowpea flour produced significantly ($p < 0.05$) higher upper layers than those from soaked cowpea irrespective of the added flour. It is possible that the time required for the hydration of the cowpea particles played a role in the separation of the phases. The particles of the reconstituted cowpea flour obviously had less time to hydrate before cooking compared with the soaked cowpea. It is also possible that the fragmentation of cowpea cotyledons in terms of the liberation of cell wall materials may have occurred in a different manner when dry mechanized milling was applied to wet milling with cowpea. Palmer (1992) reported differences in functional properties arising from different milling methods for sorghum. When maize flour or soy/maize flour was added to soaked cowpea, the upper layer that occurred was close to that reported for soaked cowpea alone by Osuji *et al.* (2011). The use of cowpea flour for the production of *moi-moi* is considered more convenient and time-saving but further work is required to determine if more time

is required for exposure of the flour particles to water before the steaming operation. The report of Osuji *et al.* (2011) also showed that increasing the temperature of the added water generally reduced the size of the upper layer. This could have been because the particle hydration will be more rapid at higher temperatures.

Table 1: Mean % upper layer of *moi-moi* from soaked cowpea and cowpea flour with added soy flour and maize flour

Processing method	Added flours		
	Soy flour	Maize flour	Soy-Maize flour
Soaked cowpea	15.20 ± 2.89[b]	8.95 ± 1.60[b]	8.27 ± 0.49[b]
Cowpea flour	21.17 ± 2.84[a]	19.72 ± 2.82[a]	14.61 ± 3.14[a]
Lsd	0.573	1.560	0.901

Means with different superscripts within same column are significantly different at $p < 0.05$

Effect of addition of soy flour and maize flour on phase separation of moi-moi from different cowpea varieties

The effect of the addition of soy flour, maize flour and soy/maize flour to *moi-moi* from different cowpea varieties is shown in *Table 2*. The per cent upper layer was greatest when soyflour was added for all varieties used. The combined soy/maize flour produced less upper layer than when either soy flour or maize flour was used alone. There were no significant ($p > 0.05$) differences in the per cent upper layers for *moi-moi* from added maize flour. The IT89KD produced higher upper layers irrespective of the added flour. This could be attributed to a genetic trait that might have predisposed this variety to the development of phases more than the others. While the highest mean per cent upper layer occurred in the *moi-moi* from IT89KD variety with added soy flour, the least mean upper layer occurred in the *moi-moi* made from Isiocha with added combined soy/maize flour.

Effect of addition of different quantities of soy flour and maize flour on phase separation of moi-moi

The effect of different levels of added soy and maize flours on phase separation in *moi-moi* is shown in

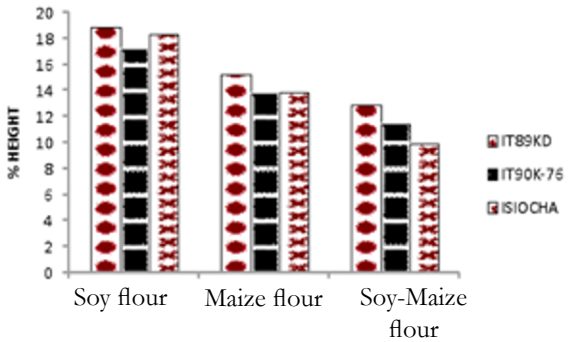

Fig. 1: Percentage height of the upper layer in *moi-moi* made from different cowpea varieties with added soy flour, maize flour and soy/maize flour

Table 2: Mean % upper layer of *moi-moi* with different levels of added soy flour, maize flour and soy/maize flour

% Added flour	Added flours		
	Soy flour	Maize flour	Soy/Maize flour
5	15.87 ± 3.91[d]	11.80 ± 4.55[b]	10.90 ± 3.07[bc]
10	16.30 ± 4.22[d]	13.65 ± 6.08[ab]	10.28 ± 3.49[c]
15	18.30 ± 3.74[c]	14.88 ± 6.02[a]	11.27 ± 3.42[bc]
20	19.40 ± 4.17[b]	15.32 ± 6.63[a]	11.95 ± 4.51[ab]
25	21.07 ± 3.54[a]	16.03 ± 7.22[a]	12.80 ± 5.53[a]
LSD	0.907	2.466	1.424

Means ±SD with different superscripts within same column are significantly different at $p < 0.05$

Table 3. The mean per cent upper layers increased with higher levels of added flour. The combined soy/maize flour produced the least upper layer for all levels of added flour. The combination of the two flours might have produced an interaction

that reduced the phase separation potential. This phenomenon is also apparent in Tables 1 and 2.

Conclusion

Addition of soy flour increased the occurrence of phase separation in *moi-moi* more than addition of maize flour. This effect was replicated in different varieties of cowpea. Different cowpea varieties manifest phase separation to varying degrees. Addition of soy flour and maize flour increased the proportion of upper layer of *moi-moi* made from dry milled cowpea more than in *moi-moi* from soaked cowpea. Addition of 1:1 blend of soy/maize flour reduced the formation of phase separation compared to when either flour is added alone. Further work is needed to understand the effect of cowpea particle hydration pattern and milling methods on the phase separation of *moi-moi*. Complete prevention of phase separation in *moi-moi* by addition of soy flour and maize flour is not feasible.

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